EXHIBIT 4

[redacted]

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
TYLER DIVISION

LONE STAR TECHNOLOGICAL INNOVATIONS, LLC,	§	
	§	**Civil Action No. 6:19-CV-00059-RWS**
***Plaintiff*,**	§	
	§	**LEAD CASE**
v.	§	
ASUSTEK COMPUTER INC.,	§	
***Defendant*.**	§	**JURY TRIAL DEMANDED**

SUPPLEMENTAL EXPERT REPORT OF ALFRED D. DUCHARME, PhD.
REGARDING INFRINGEMENT OF U.S. PATENT 6,724,435:

ASUSTeK Computer Inc. (“ASUS”)

[redacted]

IX. INFRINGEMENT OF CLAIMS 1–3, 5-6 & 13-15 OF THE '435 PATENT

The opinions that I provide in this report are based on my nearly 30 years of professional experience in the relevant field of in display technology as detailed in my Curriculum Vitae attached to this report. The following is a high-level description of my process of reaching the conclusions contained in this report. I evaluated the evidence to determine whether each of the limitations of asserted claims of the '435 Patent – in light of the Court's Claim Construction Order defining certain terms contained in those limitations – were present in each of the Accused Devices. In my analysis, I conducted a careful review and considered the operations and capabilities of the Accused Devices and ASUS's materials along with the other materials listed in in this report, to reach my conclusions contained in this report.

It is my opinion that all of the limitations of each asserted claim are met by the Accused Devices as detailed below. As a result, my conclusion is that the Accused Devices infringe upon the asserted claims of the '435 Patent.

The following section describes in more detail support for my opinions of infringement with regard to ASUS Accused Devices in light of the asserted claims. For purposes of brevity, my explanation below concerns an exemplary product, ASUS PA328Q:

[redacted]

My analysis in support of my opinions in this Report include the testing of the color functionality of the aforementioned Accused Device. Attached to this Report is a more detailed explanation of my testing, analysis and results Exhibits 1 & 2 (which I incorporate by reference herein). The testing I performed on the Accused Device confirms my opinions herein. Further, the opinions provided in this Report concern and apply to all ASUS Accused Products since the functionality among the Accused Products is essentially the same.

An additional ASUS device was also tested, model VG248QE, which exhibited similar results. It is important to note that this device only allowed for 3-axis hue control.

Since the authoring of my original expert report, I have had the opportunity to review excerpts of [redacted] As a result, my analysis and opinions are the same regardless of which chip set is used by ASUS's Accused Products.

As I stated in my original report, it is not necessary to review the MediaTek source code in forming my opinions because infringement is confirmed by the operation of the Accused Products, but my review of the MediaTek source code confirms the opinions stated in my original report. I reserve the right to supplement this report if necessary, after I have had the opportunity to review any additio9nal discovery that is provided (*e.g.* ASUS's depositions).

[redacted]

between the image source and display device is an "HDMI" interface (which stands for "High Definition Multimedia Interface,"). It supports the transmission of video data in the sRGB color space as well as YCbCr color space. However, both color formats contain input data that includes color or color component values that are plotted in an input grid of a display device to be rendered by the display.

49. Specifically, ASUS's Accused Devices must receive and characterize an input source otherwise the device would be incapable of rendering an output video. Said another way, it is technically necessary for an Accused Device to receive and characterize an input signal in a particular color space (sRGB or otherwise), or else it would not be able to render an output video. Additionally, if the Accused Device does not literally infringe by receiving and characterizing an input source, then it infringes under the doctrine of equivalents. The Accused Devices are capable of achieving substantially similar results using insubstantially different operations. For example, the Accused Device's capability of receiving and characterizing an input from either (for example) an HDMI or DVI input source, it is still capable of rendering a video output image. Thus, in my opinion this claim limitation is satisfied.

A review of MediaTek's Source Code further confirms that the Accused Device performs this claim limitation. For example, in the file [redacted]

[redacted]

[redacted]

[redacted] This confirms the real time digital video input image received and characterized by the Accused Device has input image pixels (in YUV format).

3. selecting to independently change the hue or the saturation of an individual color in the real time digital video input image, by selecting an independent color hue control delta value or an independent color saturation control delta value, respectively, wherein said independent color hue control delta value represents an extent of change in the hue of said selected individual color and wherein said independent color saturation control delta value represents an extent of change in the saturation of said selected individual color;

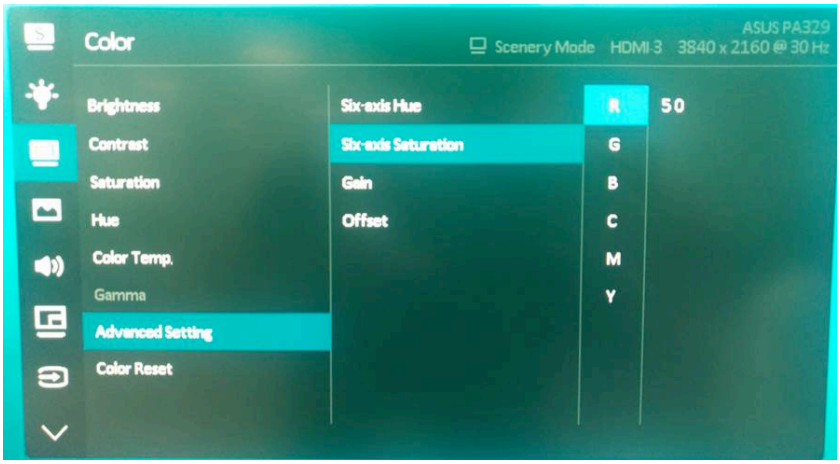
50. As previously referenced, "ASUS features an advanced color adjustment so you can individually customize hue and saturation for each axis color under the Scenery mode and Dark mode. For example, you can adjust the six colors (red, green, blue, cyan, magenta, and yellow) ***without affecting the output of the other colors."*** [9]

51. Each Accused Device allows for the selection of an individual color in the video input image. As referenced and explained in many of the user manuals, the Accused Devices are enabled to allow for hue and saturation changes to individual colors. ASUS PA328Q manual illustrates the functionality of the display to achieve same:[10]

[9] LSTI-ASUS-7332-66
[10] ASUS PA328 Series LCD Monitor User Guide p. 3-2 (available at https://dlcdnets.asus.com/pub/ASUS/LCD%20Monitors/PA328/PA328_English.pdf)

[redacted]

[redacted]



55. If I were to adjust the saturation of the individual color red from 50 to 100, the "extent of change" would be 50—the difference between the existing value and the increase or decrease of saturation. This is the same for hue.

56. Importantly, the claim limitation does not require a specific control delta value. Whether a device provides an adjustment scale of 0-50, -1 to 1, of 1 to 100 is not claimed. Thus, in my opinion, this claim limitation is satisfied.

57. Review of MediaTek's Source Code further confirms my opinion. [redacted]

[redacted]

[redacted]

[redacted]

4. identifying a plurality of said input image pixels having said selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by performing arithmetic and logical operations using input image pixel values of each said input image pixel of the real time digital video input image;

58. The next step of claim 1 requires the identification of one or more pixel values having the selected individual color to be changed, using arithmetic and logical operations of said values. The Accused Devices satisfies this limitation as explained below.

59. First, based on my knowledge, training and experience in the field, I am aware that the basics of display technology involve the use of pixel values.

60. For every pixel on a display, a pixel value is expressed in order for the device to ultimately render an image, pixel by pixel, frame by frame.

61. As previously noted, the construction of input image pixels means "input data that includes color or color component values and that can be plotted in an input grid of a display device." In other words, input image pixels are merely values of colors associated pixels typically (but not necessarily) expressed in coordinates (*i.e.* grids).

62. Based on my knowledge, training and experience in the manner in which digital display devices operate, for any color changes, whether it involves adjusting the saturation of the entire image or that of an individual color, the color change occurs by the manipulation of the input image pixel values. As one source explains:[14]

[14] KEITH JACK, VIDEO DEMYSTIFIED: A HANDBOOK FOR THE DIGITAL ENGINEER (Elsevier 4th ed. 2005) p. 16.

[redacted]

[redacted]

Semiconductor provides microprocessors for many ASUS Accused Devices.[16] And, because microprocessors necessarily perform calculations and functions *using* arithmetic and logical operations—math and logic, basic arithmetic and compare functions— the Accused Devices therefore satisfy this claim limitation.

65. Further, each of the Accused Devices also use software instructions executing on the processor chip to recognize the user's selection of color adjustments wherein pursuant to such selection, the software instructions generally transform the measured color space (*i.e*. the color points as measured on the input video stream) to the desired color space (*i.e*. the output according to the custom color mode). It is well understood that a processor executing such software instructions necessarily comprises one or more arithmetic and logical units (ALUs) and a control unit (CU). An ALU is responsible for arithmetic operations (*e.g*. addition, subtraction, *etc*.) and for logical operations (*e.g*. such as and, or, *etc*.) A. Processors routinely use these arithmetic and logical operations to transform data stored in registers. Therefore, it is my opinion that in converting the color space from measured color space to desired color space - and selectively adjusting the colors represented by input image pixels, the processor in each respective Accused Device necessarily use arithmetic and logical operations for identifying the image pixels in the input image , recognizing the color point of the pixel in accordance with the measured color space and for transforming the color point of the pixel to one in accordance with the desired color space.

66. A review of MediaTek's Source Code further confirms that the Accused Device performs this claim limitation. For example, in the file [redacted]

[16] I have provided a "tear down" to this report shown as Exhibit 3 and incorporated by reference.

[redacted]

[redacted]

70. Importantly, the claim does not require a specific method of achieving changes to hue or saturation of an individual color in digital video, just that the identification of the pixels to be changed. Based on my knowledge, training and experience in the field, I am of the opinion that it is certainly beyond a preponderance that display processors operate by using arithmetic and logical operations by their nature. For that reason alone, it was not necessary for me to analyze the source code. However, my subsequent review of the source code confirms my opinions. Thus, in my opinion, this claim limitation is satisfied. Additionally, if the Accused Devices do not literally infringe this recited step, then they infringe under the doctrine of equivalents. The Accused Device is capable of achieving substantially similar results using insubstantially different operations. For example, the Accused Devices are capable and do achieve identifying the pixel values with the individual color to be changed and applying the change to either hue or saturation. Those values do change accordingly, as confirmed and explained by my testing of the Accused Products. Therefore, even if the Accused Devices, for example, uses a matrix or LUT transform, it still achieves substantially similar results with insubstantially different operations.[17]

[17] To the extent additional discovery (e.g. ASUS depositions, *etc.*) is subsequently produced, discovered or made available, I reserve the right to supplement this report and my opinions contained herein.

[redacted]

#	Test Color	Test Red	Test Green	Test Blue	Delta Red	Delta Green	Delta Blue	Delta Magenta	Delta Yellow	Delta Cyan	X	Y	Z	L	a	b	Delta E
White Test		255	255	255	50	50	50	50	50	50	174.5611	182.33128	230.82326	100	0	0	
2		255	0	0	50	50	50	50	50	50	75.544175	37.591525	1.9009519	52.527924	82.820712	77.739372	
3		255	0	0	50	0	50	50	50	50	75.20892	37.428365	1.8960898	52.428636	82.688384	77.60099	0.22
4		255	0	0	50	100	50	50	50	50	75.116859	37.37958	1.8903366	52.398892	82.66244	77.588526	0.25
5		255	0	0	50	50	0	50	50	50	74.969218	37.308933	1.887291	52.355774	82.600818	77.534734	0.35
6		255	0	0	50	50	100	50	50	50	74.906773	37.278467	1.8916463	52.337163	82.576271	77.473259	0.41
7		255	0	0	50	50	50	0	50	50	74.797958	37.225922	1.8894681	52.30504	82.532026	77.432572	0.48
8		255	0	0	50	50	50	100	50	50	74.719029	37.189075	1.8899743	52.282496	82.496562	77.390287	0.54
9		255	0	0	50	50	50	50	0	50	74.687905	37.173494	1.8893485	52.272959	82.485343	77.378066	0.55
10		255	0	0	50	50	50	50	100	50	74.647729	37.156029	1.890232	52.262265	82.463868	77.353667	0.59
11		255	0	0	50	50	50	50	50	0	74.603148	37.131494	1.8920812	52.247236	82.453641	77.31528	0.63
12		255	0	0	50	50	50	50	50	100	74.572767	37.118165	1.8918406	52.239069	82.437712	77.302822	0.65
13		0	255	0	50	50	50	50	50	50	55.230275	125.23242	15.154151	86.347331	-100.4462	95.778168	
14		0	255	0	0	50	50	50	50	50	55.213683	125.18388	15.153901	86.334106	-100.4233	95.75581	0.03
15		0	255	0	100	50	50	50	50	50	55.204727	125.15872	15.154644	86.327249	-100.4122	95.74267	0.05
16		0	255	0	50	50	0	50	50	50	55.163456	125.05962	15.152288	86.300235	-100.3806	95.700275	0.11
17		0	255	0	50	50	100	50	50	50	55.169444	125.06881	15.157057	86.302741	-100.3791	95.696132	0.11
18		0	255	0	50	50	50	0	50	50	55.132977	124.97517	15.151422	86.277203	-100.3441	95.662101	0.17
19		0	255	0	50	50	50	100	50	50	55.12916	124.97235	15.152163	86.276433	-100.3486	95.659459	0.17
20		0	255	0	50	50	50	50	0	50	55.114728	124.92541	15.156958	86.263627	-100.3232	95.628869	0.21
21		0	255	0	50	50	50	50	100	50	55.106792	124.90594	15.156053	86.258314	-100.3166	95.621315	0.22
22		0	255	0	50	50	50	50	50	0	55.07763	124.83867	15.152861	86.239953	-100.2975	95.595323	0.26
23		0	255	0	50	50	50	50	50	100	55.085403	124.85057	15.161128	86.243201	-100.2955	95.586254	0.27
24		0	0	255	50	50	50	50	50	50	40.47848	15.666638	209.93193	35.187376	86.546629	-105.5203	
25		0	0	255	0	50	50	50	50	50	40.471164	15.660981	209.9158	35.181214	86.554681	-105.5259	0.01
26		0	0	255	100	50	50	50	50	50	40.477658	15.663883	209.97157	35.184375	86.557484	-105.5376	0.02
27		0	0	255	50	0	50	50	50	50	40.475574	15.661051	209.95027	35.18129	86.565509	-105.5364	0.03
28		0	0	255	50	100	50	50	50	50	40.484409	15.665704	210.02796	35.186359	86.566011	-105.5516	0.04
29		0	0	255	50	50	50	0	50	50	40.472217	15.660293	209.96104	35.180465	86.560576	-105.5411	0.03
30		0	0	255	50	50	50	100	50	50	40.475249	15.66	209.9822	35.180145	86.569622	-105.5482	0.04
31		0	0	255	50	50	50	50	0	50	40.472524	15.658622	209.97111	35.178644	86.569199	-105.5474	0.04
32		0	0	255	50	50	50	50	100	50	40.509232	15.671264	210.18491	35.192413	86.602686	-105.5894	0.09
33		0	0	255	50	50	50	50	50	0	40.493683	15.664473	210.10256	35.185018	86.595246	-105.5768	0.07
34		0	0	255	50	50	50	50	50	100	40.502038	15.668183	210.14868	35.189058	86.598957	-105.584	0.08
35		255	0	255	50	50	50	50	50	50	114.25402	51.968105	211.73541	60.339602	105.07154	-62.70766	
36		255	0	255	0	50	50	50	50	50	114.24564	51.960669	211.7959	60.33596	105.07662	-62.73245	0.03
37		255	0	255	100	50	50	50	50	50	114.23966	51.955163	211.85315	60.333264	105.08067	-62.7546	0.05
38		255	0	255	50	0	50	50	50	50	114.24772	51.956712	211.92497	60.334023	105.08761	-62.77526	0.07
39		255	0	255	50	100	50	50	50	50	114.27705	51.967585	212.02698	60.339347	105.10181	-62.79726	0.09
40		255	0	255	50	50	0	50	50	50	114.15316	51.914224	211.81923	60.313209	105.05752	-62.77881	0.08
41		255	0	255	50	50	100	50	50	50	114.22164	51.941348	211.98129	60.326498	105.08701	-62.80545	0.10
42		255	0	255	50	50	50	50	0	50	114.16582	51.914382	211.92172	60.313287	105.07323	-62.81002	0.11
43		255	0	255	50	50	50	50	100	50	114.20363	51.928805	212.02721	60.320353	105.09068	-62.83008	0.13
44		255	0	255	50	50	50	50	50	0	114.18008	51.920427	212.00407	60.316249	105.07853	-62.83008	0.12
45		255	0	255	50	50	50	50	50	100	114.17531	51.918354	212.03115	60.315233	105.07687	-62.84011	0.13
46		255	255	0	50	50	50	50	50	50	129.76173	161.22572	16.059389	95.339441	-26.97585	109.70624	
47		255	255	0	0	50	50	50	50	50	129.73289	161.15875	16.060057	95.324023	-26.94295	109.67851	0.05
48		255	255	0	100	50	50	50	50	50	129.67403	161.09466	16.052368	95.309264	-26.94784	109.6662	0.06
49		255	255	0	50	0	50	50	50	50	129.65308	161.07214	16.055591	95.304077	-26.94987	109.65175	0.07
50		255	255	0	50	100	50	50	50	50	129.66789	161.08112	16.055664	95.306145	-26.94155	109.65519	0.07
51		255	255	0	50	50	0	50	50	50	129.61477	161.01927	16.053387	95.291897	-26.94198	109.63452	0.09
52		255	255	0	50	50	100	50	50	50	129.67992	161.09198	16.064286	95.308647	-26.93833	109.64478	0.08
53		255	255	0	50	50	50	0	50	50	129.60568	161.00486	16.056001	95.288577	-26.93825	109.62433	0.10
54		255	255	0	50	50	50	100	50	50	129.64268	161.03872	16.064379	95.296378	-26.9288	109.62347	0.10
55		255	255	0	50	50	50	50	50	0	129.57212	160.95713	16.0545	95.277579	-26.92993	109.60793	0.12
56		255	255	0	50	50	50	50	50	100	129.63583	161.03484	16.067364	95.295484	-26.93292	109.61684	0.11
57		0	255	255	50	50	50	50	50	50	95.373828	140.24726	226.035	90.284286	-49.36613	-15.35861	
58		0	255	255	0	50	50	50	50	50	95.36856	140.24343	226.01774	90.283318	-49.36948	-15.35522	0.00
59		0	255	255	100	50	50	50	50	50	95.390526	140.25995	226.11327	90.287491	-49.35609	-15.376	0.02
60		0	255	255	50	0	50	50	50	50	95.37223	140.23269	226.08789	90.280605	-49.35255	-15.38044	0.03
61		0	255	255	50	100	50	50	50	50	95.408331	140.2801	226.19358	90.292581	-49.3526	-15.39074	0.04
62		0	255	255	50	50	0	50	50	50	95.362155	140.2174	226.0633	90.276742	-49.35029	-15.3799	0.03
63		0	255	255	50	50	100	50	50	50	95.41051	140.27375	226.2251	90.290977	-49.34257	-15.40273	0.05
64		0	255	255	50	50	50	0	50	50	95.414358	140.27018	226.23023	90.290075	-49.33319	-15.40579	0.06
65		0	255	255	50	50	50	100	50	50	95.382384	140.20949	226.21246	90.274744	-49.31278	-15.42702	0.09
66		0	255	255	50	50	50	50	0	50	95.38258	140.20868	226.21388	90.274539	-49.31161	-15.42779	0.09
67		0	255	255	50	50	50	50	100	50	95.388854	140.21565	226.21982	90.2763	-49.31024	-15.42649	0.09

76. A review of MediaTek's Source Code further confirms that the Accused Device performs this limitation. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6. If the Accused Devices do not literally infringe this recited step, then they infringe under the doctrine of equivalents. The Accused Device is capable of achieving substantially similar results using insubstantially different operations. displaying a real time digital video output image including said corresponding plurality of said output image pixels having said selected individual color with the hue or the saturation selected to be independently changed in the real time digital video input image, whereby the hue or the saturation of said selected individual color in the real time digital video input image has been changed without affecting the hue or the saturation of any other individual color in the real time digital video input image.

77. The primary objective of any display device is to render the characterized, processed or adjusted, image to the user. It is also preferred that this operation occur at high speed so that the operations described previously do not delay the displayed image. Once the input image has been characterized and processed it is then displayed using standard electronic means of transferring the colors and geographical pixel information to the LCD panel. This is typically performed by a LCD controller application specific integrated circuit. In reviewing the electronic make-up of the Accused Device identified such a device the AOU-12409 LCD controller. The output of this device most likely adheres to industry standards utilizing the common Low-voltage differential signaling, or LVDS, also known as TIA/EIA-644 (standard). This cable is the electronic means by which the processed image is transferred to the LCD panel for display.

78. It is my opinion, is that the Accused Device satisfies the first part of this claim by displaying the processed input image onto the display.

79. Further, my own test results of the Accused Device prove conclusively that the second part of the claim is satisfied. Specifically, the adjustment of a selected

[redacted]

[redacted]

individual color by the user resulted in no change in color of the other individual colors in the displayed image.

80. Thus, the Accused Devices meet each and every limitations of the steps of Claim 1 of the '435 Patent.

81. Finally, based on my knowledge, training and experience, a user of an Accused Device will at least implement the patented technology one time to initialize the proper setup and adjust the colors of the display or projector.

82. In fact, based on my knowledge, training and experience, I understand that color calibration is recommended at between 200-300 hours of use[19] or at least 2-6 weeks to ensure color accuracy in displays. [20]

83. Further, because many if not all manufactures implement some form of quality control, because color accuracy matters to its customers, I am of the opinion that the Defendants practice the claimed method even before the Accused Devices are put on the market for sale. For example, ASUS represents that its "ProArt Display PA248QV is factory calibrated and Calman Verified to guarantee industry-leading color accuracy. Every ProArt display undergoes s*tringent, meticulous testing to ensure smoother color gradation*. Consumer of pro, you're assured color-accurate viewing and content-creation experiences."[21]

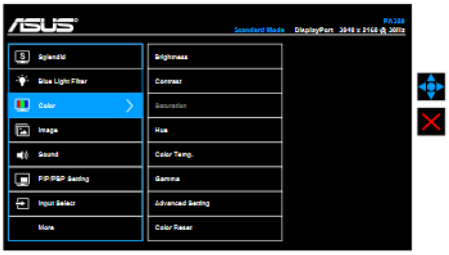
84. Moreover, based on my analysis of the Accused Devices, it is of my opinion that ASUS provides plain instructions to its users on exactly how to implement the

[19] LSTI002871-73
[20] LSTI002921-32
[21] https://www.asus.com/us/Monitors/ProArt-Display-PA248QV

[redacted]

3. **Color**

Set a desired color setting from this menu.



- **Brightness**: The adjusting range is from 0 to 100.
- **Contrast**: The adjusting range is from 0 to 100.
- **Saturation**: The adjusting range is from 0 to 100.
- **Hue**: Shifts the image color between green and purple.
- **Color Temp.**: Contains 4 modes including 9300K, 6500K, 5500K and 5000K.
- **Gamma**: Allows you to set the color mode to 2.4, 2.2 or 1.8.
- **Advanced Setting**:
  - 6-axis Hue adjustment.
  - 6-axis Saturation adjustment.
  - Adjusts the gain levels for R, G, B.
  - Adjusts the black level offset values for R, G, B.

91. Because ASUS uses a numerical range of 0 to 100 for hue and saturation controls, this claim is satisfied.

92. A review of MediaTek's Source Code confirms the Accused Device performs this claim limitation. [redacted]

[redacted]

E. Claim 6

1. The method of claim 1, whereby in step (b), numerical range of said independent color hue control delta value is an interval between −1 and +1.

93. The Accused Device utilizes a range of values between 0 to 100. However, the default value of these settings is 50. The user can apply a greater amount of an individual color by increasing the setting above 50. The opposite is also true for the Accused Device, a setting below 50 results in a reduction of the amount of an individual color. The range displayed to the user are 0 to 100 but could also easily be expressed using -1-to-1 since the sign of this notation represents the values utilized by the device considering that the default value is 50. The range of 0-to-100 can be adjusted by subtracting 50 to transform the interval to -50-to-50. The division of this range by the central value of 50 yields the new range of -1-to-1.

94. It is my opinion that the Accused Device infringes this claim since the number displayed to the user is inconsequential.

[redacted]

[redacted]

H. Claim 15

1. The method of claim 1, whereby in step (d), for independently controlling the saturation of said selected individual color in the real time digital video image, said independent color saturation control function is a function of said input image pixel values of said plurality of said input image pixels and of said corresponding selected independent color saturation control delta value.

99. The Accused Device allows the user to adjust an individual color in the real time video as a function of the saturation of the input image pixel values. This adjustment is actuated using an independent color saturation control value through an On-Screen-Display. It is my opinion that the Accused Device employs this claim.

I swear under penalty of perjury that the foregoing is true and correct.

Dated: October 29, 2020

Respectfully Submitted,

Alfred D. Ducharme